Hybrid Element Method for Mid-Frequency Vibroacoustic Analysis, Phase I

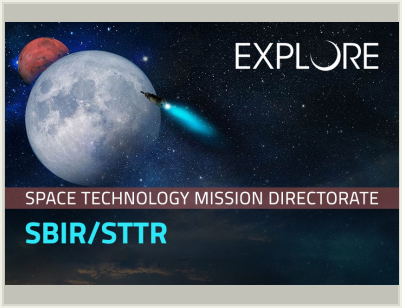
Completed Technology Project (2009 - 2009)

Project Introduction

In many situations, aerospace structures are subjected to a wide frequency spectrum of mechanical and/or acoustic excitations and therefore, there is a need for the development of numerical modeling techniques that are applicable for the resolution of dynamic response of complex systems spanning the entire frequency spectrum. However, the dynamic behavior of these structures at different frequency range is governed by different phenomena and as a result, a single numerical solution procedure is not suitable for the resolution of the entire frequency spectrum. Thus, on the basis of the numerical modeling techniques, the frequency spectrum is typically divided into three regions; low frequency region, mid-frequency region and high frequency region. The low frequency region is the frequency range where the characteristic dimensions of all component members of a vibroacoustic system are short with respect to wavelengths and these members are also referred to as 'short' members. On the other hand, in the high frequency region, the characteristic dimensions of all component members are long with respect to wavelengths and these members are referred to as 'long' members. There exists a broad mid frequency region in which not only some components are long and others are short with respect to wavelengths The proposal is directed towards the development of an innovative hybrid element method by coupling deterministic, transition and statistical Finite Element Methods to yield a solution system that is applicable for the solution of full frequency spectrum vibroacoustic prediction of nonuniform aerospace structures including metallic/composite configurations, accurately and efficiently.

Anticipated Benefits

Potential NASA Commercial Applications: The proposed development will extend and enhance the computational modeling capabilities in many industries such as automotive, naval, heavy equipment and consumer products. Customers equate quality of a product with the sound the product makes. As a result of elevated demand for quieter products from customers together with the increased government regulations, manufactures of products with noise problem in all industries are searching for effective ways to make products with improved noise characteristics. For example, in automotive industry, the increased use of multi-media and telemetric devices demands quieter vehicle interiors and the manufactures and suppliers of interior products not only need to consider functionality, but also the noise control capability of the products. Consequently, there is increasing demand for tools based on computer simulation that can be used to guide design at the early design stage. Further, the software can be adapted to evaluate and improve radiated noise from engines, exhaust, tires, etc. It can be used to evaluate and improve consumer products such as compressors, air conditioners, hairdryers, vacuum cleaners, and washing machines.



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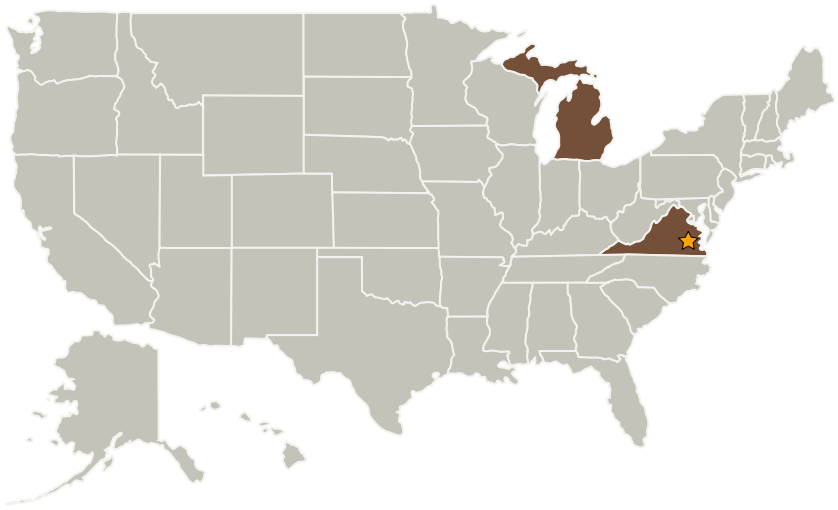
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Langley Research Center(LaRC)	Lead Organization	NASA Center	Hampton, Virginia
Comet Technology Corporation	Supporting Organization	Industry	Ann Arbor, Michigan

Primary U.S. Work Locations	
Michigan	Virginia

Project Transitions

January 2009: Project Start

July 2009: Closed out

Closeout Summary: Hybrid Element Method for Mid-Frequency Vibroacoustic A nalysis, Phase I Project Image

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Langley Research Center (LaRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

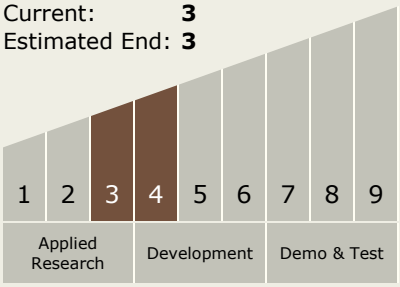
Carlos Torrez

Principal Investigator:

Satha Raveendra

Technology Maturity (TRL)

Start: **4**
Current: **3**
Estimated End: **3**



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Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.5 Structural Dynamics
    - TX12.5.2 Vibroacoustics